

INTERIM RECOVERY PLAN NO. 169

MOUNTAIN VILLARSIA

(*VILLARSIA CALTHIFOLIA*)

INTERIM RECOVERY PLAN

2004-2009

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Photo: Ellen Hickman

July 2004

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FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or IRPs and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP will operate from July 2004 to June 2009 but will remain in force until withdrawn or replaced. It is intended that this IRP will be reviewed after five years and the need for a full Recovery Plan will be assessed.

This IRP was given regional approval on 14 June 2004 and was approved by the Director of Nature Conservation on 22 July 2004. The allocation of staff time and provision of funds identified in this IRP is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at July 2004.

ACKNOWLEDGMENTS

The following people have provided assistance and advice in the preparation of this IRP:

Charlie Salamon Ranger-in-Charge Porongurup National Park.
Andrew Brown Threatened Flora Coordinator, CALM WATSCU

Thanks to the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and CALM's Wildlife Branch for assistance.

SUMMARY

Scientific Name:	<i>Villarsia calthifolia</i>	Common Name:	Mountain villarsia
Family:	Menyanthaceae	Flowering Period:	September to December
CALM Regions:	South Coast	CALM District:	Albany Work Centre
Shires:	Plantagenet	Recovery Team:	Albany District Threatened Flora Recovery Team

Illustrations and/or further information: Aston, H.I. (1969). The genus *Villarsia* (Menyanthaceae) in Australia. *Muelleria* 2:3-63; Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia; Western Australian Herbarium (1998) FloraBase - Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia. <http://www.calm.wa.gov.au/science/>.

History and current status: *Villarsia calthifolia* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in November 1980 and ranked as Endangered (EN) in 1997. The species is also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It currently meets World Conservation Union (IUCN 2000) Red List Category 'EN' under criteria C2a as there is a continuing decline in the number of mature individuals and no subpopulation is estimated to contain more than 250 mature individuals. Nine populations and 582 mature plants are currently known. The main threats are weeds, drought, inappropriate fire regimes and grazing.

Habitat requirements: *Villarsia calthifolia* is restricted to the Porongurup Range where it is found in moist sheltered positions on the upper slopes of granite outcrops, most populations occurring above 400m in altitude.

Critical habitat: The critical habitat for *Villarsia calthifolia* comprises the area of occupancy of known population; similar habitat within 200 metres of known population; and additional nearby occurrences of similar habitat that do not currently contain the species but may have done so in the past and may be suitable for translocations.

Habitat critical to the survival of the species, and important populations: Given that this species is listed as Endangered it is considered that all known habitat is critical to the survival of the species and all populations, including translocated ones, are important populations.

Benefits to other species/ecological communities: Although *Villarsia calthifolia* does not occur in a listed threatened ecological community (TEC) the 'Porongurup granite community' is unique and has a high nature conservation value. It also contains several other threatened plant taxa including *Sphenotoma drummondii* (DRF), *Acacia heteroclita* subsp. *valida* (P2), *Degelia flabellata* (P2), *Stylidium corymbosum* var. *proliferum* (P2), *Asplenium aethiopicum* (P4), *Brachysema subcordatum* (P4) and *Hibbertia porongurupensis* (P4). *Apium prostratum* subsp. *phillipii* (DRF) occurs in drainage lines downslope from *Villarsia calthifolia*. The 'Porongurup granite community' and the other DRF / Priority species found in it will benefit from the recovery actions of weed control and fire management put in place for *Villarsia calthifolia*.

International obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that convention. The taxon is not listed under any specific international treaty, however, and therefore this IRP does not affect Australia's obligations under any other international agreements.

Role and interests of indigenous people: According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register, no sites have been discovered near the *Villarsia calthifolia* populations. Input and involvement will be sought from any Noongar groups that have an active interest in the areas that are habitat for *V. calthifolia*.

Social and economic impacts: The implementation of this recovery plan has minimal social and economic impact as all populations are on Department of Conservation and Land Management (CALM) managed land.

Evaluation of the Plans Performance: CALM, in conjunction with the Albany District Threatened Flora Recovery Team (ADTFRT) will evaluate the performance of this IRP. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following five years of implementation.

Existing Recovery Actions: The following recovery actions have been or are currently being implemented

1. CALM (Albany Work Centre) and the Ranger in Charge (Porongurup NP) have been notified of the location and threatened status of the species.
2. Weed control in the Porongurup National Park has been implemented by staff from CALM's Albany Work Centre.
3. Seed collections have been made by staff from CALM's Department's Threatened Flora Seed Centre (TFSC).
4. Volunteers and staff from the CALM's Albany Work Centre regularly monitor populations.

IRP Objective: The objective of this Interim Recovery Plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild.

Recovery criteria

Criteria for success: The removal or reduction of identified threats resulting in an increase by ten percent or more in the number of individuals within populations and/or the stabilising of the population over the period of the plan's adoption under the EPBC Act.

Criteria for failure: Continuation of identified threats resulting in a decrease by ten percent or more in the number of individuals within populations, over the period of the plan's adoption under the EPBC Act.

Recovery actions

1. Coordinate recovery actions.
2. Monitor populations.
3. Conduct further surveys
4. Undertake weed control.
5. Develop and implement a fire management strategy.
6. Collect seed and cutting material.
7. Promote awareness
8. Obtain biological and ecological information.
9. Review the IRP and assess the need for a full Recovery Plan.

1. BACKGROUND

History

The first collection of *Villarsia calthifolia* was made from the Porongurup Range by Baron Ferdinand von Mueller in 1868.

Villarsia calthifolia was declared as Rare Flora in November 1980. At that time it was known from five populations in the Porongurup Range. Surveys undertaken since then by staff from the Department's Science Division and Albany Work Centre have resulted in the discovery of four new populations. Nine populations and 582 mature plants are currently known. It currently meets World Conservation Union (IUCN 2000) Red List Category 'EN' under criteria C2a as there is a continuing decline in the number of mature individuals and no subpopulation is estimated to contain more than 250 mature individuals. The main threats are weeds, drought, inappropriate fire regimes and grazing. Weeds include *Cerastium glomeratum*, *Erodium cygnorum*, *Parentucellia viscosa*, *Stellaria media*, *Carduus* sp, *Romulus romea*, *Arctotheca calendula*, *Cotula bipinnata*. Encroaching upslope into *V. calthifolia* habitat are blackberry (*Rubus fruticosus*), red valerian (*Centranthus ruber*), taylorina (*Psoralea pinnata*), dolichos (*Dipogon lignosis*) and forget-me-not (*Myosotis sylvatica*) (Barrett 2002).

Description

Villarsia calthifolia is an erect, semi-succulent perennial herb growing to 40 cm high when not in flower and up to 75 cm when flowering. The stem and leaf stalks are grooved, the former up to 1 cm wide. The leaves, which have toothed margins, are round except for a slit on one side of the stalk, and are shaped like a shallow funnel or cup. Erect, many branched stems bear numerous flowers, each 1 cm long, including the protruding style. The flowers are yellow with 5 broad sepals and 5 petals, which are united at the base and 5 stamens that are fused to the petal tube. The flowers are borne on long, leafless stalks. Capsules are 1cm long and open at the top into 4 valves to release the seed (Brown *et al.* 1998).

Villarsia marchantii is a similar but much smaller species that occurs in seasonally wet loams on mid-slopes below populations of *V. calthifolia*. Hybrids between the two species occur in the overlap zone (Robinson and Coates 1995).

Distribution and habitat

Villarsia calthifolia is restricted to the Porongurup Range where it occurs in moist sheltered positions on the upper slopes of granite outcrops (Brown *et al.* 1998). Most populations occur above 400m in altitude. The species favors lithic conditions along crevices and under rock overhangs in total or partial shade. Soil ranges from wet in winter to moist in summer (Dixon and Pate 1981).

The species occurs in the 'Porongurup granite community' which contains several other threatened plant taxa including *Sphenotoma drummondii* (DRF), *Acacia heteroclita* subsp. *valida* (P2), *Degelia flabellata* (P2), *Stylidium corymbosum* var. *proliferum* (P2), *Asplenium aethiopicum* (P4), *Brachysema subcordatum* (P4) and *Hibbertia porongurupensis* (P4). *Apium prostratum* subsp. *phillipii* (DRF) occurs in drainage lines downslope from *Villarsia calthifolia*.

Biology and ecology

Villarsia is a widespread genus of sixteen species distributed throughout southeastern Asia, Australia and South Africa. Most, however, are centered in Western Australia where ten species are found. These are largely restricted to the South West Botanical Province (Ornduff 1996).

Species of the genus *Villarsia* display a diversity of breeding systems. *Villarsia calthifolia* has a self-compatible system whereby the female reproductive cells are capable of self-fertilisation by male gametes from the same individual. Associated with this are flowers with two forms, one long and one short-styled. A study on the fecundity and population composition of a number of species of *Villarsia* in Western Australia found that the *V. calthifolia* had these two flower forms in a ratio of 1:1, long to short styled and demonstrated no reproductive

advantage to having the dual-styled forms in these species. The two flower forms *Villarsia calthifolia* produce copious seeds after artificial self-fertilisation as well as after cross-pollination between the two forms (Ornduff 1986).

Flowering and seed set are prolific with up to 100 fertile seeds per capsule. Vegetative propagation has only been observed as multiple stem shooting (Dixon and Pate 1981).

The species has a fleshy underground storage organ formed from adventitious roots that provides a reserve of water and nutrients to sustain the plant through adverse conditions and enables rapid growth when conditions become favorable (Pate and Dixon 1982).

Villarsia calthifolia is considered to be fire sensitive with mature plants dying following 100% leaf scorch (Greg Keighery, unpublished). However, two mature plants were observed to resprout after a fire in May 2003 (S Barrett personal communication³). Greg Keighery (CALM) also noted numerous seedlings in the Devil's Slide population following fire in 1988 and good winter rains. It is thought that fire may also enhance germination (Ornduff 1990) and occasional fire may be necessary for recruitment. However; inter-fire seedling establishment has been observed at most populations (S Barrett personal communication³).

Despite the possession of a fleshy, underground storage organ, the species appears to be adversely affected by drought as is evidenced by the number of dead plants seen at the end of a drought year in 1979 (Dixon and Pate 1981), and after a period of extreme heat in January 1991 (Robinson and Coates 1995).

The response of *Villarsia calthifolia* to disturbance other than fire is unknown. Individual plants on walking trails have been trampled but it is not known if this kills the plant.

The species was rated as resistant to *Phytophthora cinnamomi* after 90 plants were inoculated (Bryan Shearer, unpub. 2002).

Seed germination was not successful under artificial conditions in one study (Dixon and Pate 1981), however, germination rates of up to 92% after 73 days have been recorded by staff of CALM's Threatened Flora Seed Centre (Anne Cochrane unpublished¹).

The species has been recorded to have a life span of only 1-2 years in cultivation (Ornduff 1990), although a plant has been grown for 5 years in a garden in close proximity to natural populations.

Threats

Villarsia calthifolia was declared as Rare Flora in 1980 and ranked as Endangered (EN) in 1997. It currently meets World Conservation Union (IUCN 2000) Red List Category 'EN' under criteria C2a. Nine populations and 582 mature plants are currently known.

The main threats are drought, weed invasion, inappropriate fire regimes, long-term climate change and damage during recreation activities.

- **Drought.** The microhabitats of *Villarsia calthifolia* are very wet in winter with water constantly percolating through the soil. Although moisture is normally retained in the rock crevices during summer, periods of drought may cause them to dry them out and result in some plants dying. This effect was recorded following a period of extreme heat in January 1991 (Robinson and Coates 1995). Plant deaths were also noted after the 1979 drought year (Dixon and Pate 1981).
- **Weed invasion** is a threat to most populations that occur in degraded habitat. Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They also exacerbate grazing pressure and increase the fire hazard due to the easy ignition of high fuel loads that are produced annually by many weed species. Specifically in granite outcrops, weed growth is most pronounced in full sun and where the soil has

¹ Anne Cochrane, Manager, CALM's Threatened Flora Seed Centre

³ Sarah Barrett, Flora Officer, CALM's Albany Work Centre

been disturbed. It is least pronounced where a dense shrub layer or low forest of native woody perennials persist (Hopper *et al.* 1997). Weeds do not constitute a major threat to *V. calthifolia* in the shallow soils and rock crevices (S. Barrett personal communication²), however, in deeper soil habitat, in open positions, and in disturbed conditions (e.g. post-fire) weeds are a potential threat to this species.

Encroaching upslope into *Villarsia calthifolia* habitat are blackberry (*Rubus fruticosus*), red valerian (*Centranthus ruber*), taylorina (*Psoralea pinnata*), dolichos (*Dipogon lignosis*) and forget-me-not (*Myosotis sylvatica*) (Barrett 2002).

A combination of historical land-use and good quality soils has resulted in an extensive distribution of a large number of weed species in the Porongurup NP. The granite plant community is at particular risk of weed invasion. Weed control in the park is implemented under the Regional Management Plan for the South Coast Region (CALM 1992) and the Stirling Range and Porongurup National Parks Management Plan 1999-2009 (CALM 1999). A specific weed control program for the Porongurup NP is planned.

- **Inappropriate fire regimes** may affect the long-term viability of populations. Information on the response of *Villarsia calthifolia* to fire is limited and it is not known if fire or other disturbance is essential for recruitment of this species. However, frequent fire that occurs before regenerating or juvenile plants have reached maturity and have replenished the soil seed bank is likely result in the loss of populations. The juvenile period is unknown for this species so the optimum fire interval cannot be determined at this stage. A cautionary approach is therefore adopted in this Plan such that fire will be excluded, where possible, from all *V. calthifolia* populations over the period of the plan's adoption under the EPBC Act.
- **Grazing.** A number of grazed plants were observed in 2003 (populations 1C, 2A and 6B). Grazing had reduced some plants to stems with no leaves while others had only some leaves grazed. It is unknown which herbivore was grazing on the plants but both rabbit and western grey kangaroo dung were present nearby. It is unlikely that western grey kangaroos would be impacting on *Villarsia calthifolia* considering the long association of these two species, however the impact of rabbit grazing may have a detrimental effects on *V. calthifolia* under high population numbers.
- **Long-term climate change** may stress populations if climate change results in increased periods of drought with individuals of *Villarsia calthifolia* known to die under drought conditions. Although there is no information available on scenarios for climate change within the Porongurup Range, its position as an outlier of the wetter forest regions to the west, with many flora species occurring here at the inland margin of their range (CALM 1999), suggest that any drying of the climate will result in the present geographic distributions of many species becoming climatically unsuitable within a very short time. It has been speculated that those groups likely to be most affected by climate change include geographically localised taxa, peripheral or disjunct populations, specialised species, poor dispersers, genetically impoverished species, and montane and alpine species (Peters & Darling 1985). Therefore, the current localized distribution of *V. calthifolia* on the top of a mountain range means that loss or degradation of appropriate habitat through climate change is a likely threat in the future.
- **Recreation** may potentially have an impact at sites where plants grow on or near footpaths. A number of plants were trampled directly on the Devils Slide Track (population 2A). In addition, populations at Nancy Peak / Hayward Peak (Populations 3A, 3B & 3C) and Castle Rock (Population 7) are close to frequently used footpaths. The provision of footpaths within these latter populations decreases the likelihood of trampling. However, the fact that people are recreating in close proximity to plants indicates that there could be a potential threat from trampling, if people leave the footpaths.

² Sarah Barrett, Flora Officer, CALM's Albany Work Centre

Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1A. Bates Peak	National Park	2002 28 (1), 1 dead 2003 23 (1000+)	Healthy	Weeds, inappropriate fire regime, drought
1B. Manyat Peak	National Park	2002 18 (1, 2 juveniles) 2003 13	Healthy	Weeds, inappropriate fire regime, drought
1C E of Manyat Peak	National Park	2002 75 2003 28 (6 juveniles, 2 burnt, 1 grazed)	Healthy	Weeds, inappropriate fire regime, drought, grazing
1D. Between Bates and Marmabup Peaks	National Park	2002 50-100	Healthy	Weeds, inappropriate fire regime, drought
2A. Devils Slide	National Park	2002 *96+ (29+) 2003 184+ (69+)	Healthy	Weeds, inappropriate fire regime, drought, trampling, grazing
2B. Base of Devils Slide and upper Bolganup Creek	National Park	2003 18	Healthy	Weeds, inappropriate fire regime, drought
3A. Nancy Peak / Morgan's View	National Park	2003 60+ (10+)		Weeds, inappropriate fire regime, drought
3B. Hayward Peak	National Park	2003 1		Weeds, inappropriate fire regime, drought
3C. West of Hayward Peak	National Park	2003 2	Healthy	Weeds, inappropriate fire regime, drought
4. North of Twin Peaks	National Park	2003 4	Healthy	Weeds, inappropriate fire regime, drought
5. Twin Peaks	National Park	1999 30+ (10+)	Healthy	Weeds, inappropriate fire regime, drought
6A. Granite Peak	National Park	2003 3 (1)	Healthy	Weeds, inappropriate fire regime, drought
6B. Collier Peak	National Park	2003 51 (17) (9 plants grazed)	Healthy	Weeds, inappropriate fire regime, drought, grazing
7. Castle Rock	National Park	2003 90+ (10)	Healthy	Weeds, inappropriate fire regime, drought
8. Walls Summit	National Park	2002 3 2003 None found, burnt	Healthy	Weeds, inappropriate fire regime, drought
9. N of Devils Slide	National Park	2003 Not found, possibly burnt		Weeds, inappropriate fire regime, drought

Numbers in brackets = number of seedlings or juveniles. * = total for subpopulations combined.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments in the immediate vicinity of the population or within the defined critical habitat of *Villarsia calthifolia* require assessment for the potential for a significant level of impact. No developments should be approved unless the proponents can demonstrate that they will not have a deleterious impact on the species, or its habitat or potential habitat, or the local surface and ground water hydrology.

Critical habitat

Critical habitat is habitat identified as being critical to the survival of a listed threatened species or listed threatened ecological community. Habitat is defined as the biophysical medium or media occupied (continuously, periodically or occasionally) by an organism or group of organisms or once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced (*Environment Protection and Biodiversity Conservation Act 1999*).

The critical habitat for *Villarsia calthifolia* comprises:

- the area of occupancy of known populations;
- areas of similar habitat (granite outcrops) within 400 metres of known populations that provide potential habitat for natural recruitment;
- additional occurrences of similar habitat that do not currently contain the species but may have done so in the past (these represent possible translocation sites).

Habitat critical to the survival of the species, and important populations

Given that this species is listed as Endangered it is considered that all known habitat is critical to the survival of the species. In addition all populations, including any translocated populations, are considered important to the survival of the species. Recovery actions include survey for further populations that would lead to the identification of additional habitat critical.

Benefits to other species/ecological communities

There are no known listed threatened ecological communities (TECs) that occur in the habitat of *Villarsia calthifolia*. However, the 'Porongurup granite community' (see above) is unique and has a high nature conservation value. This community also contains several other threatened taxa: *Sphenotoma drummondii* (DRF), *Hibbertia porongurupensis* (P4), *Brachysema subcordatum* (P4), *Asplenium aethiopicum* (P4), *Acacia heteroclita* subsp. *valida* (P2), *Degelia flabellata* (P2) and *Stylidium corymbosum* var. *proliferum* (P2). *Apium prostratum* subsp. *phillipii* (DRF) occurs in drainage lines down slope from *V. calthifolia*. The 'Porongurup granite community' and its associated DRF / Priority flora species will benefit from weed control and fire management put in place for the *V. calthifolia*.

International obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that convention. The taxon is not listed under any specific international treaty, however, and therefore this IRP does not affect Australia's obligations under any other international agreements.

Role and interests of indigenous people: According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register, no sites have been discovered near the *Villarsia calthifolia* populations. Input and involvement will be sought from any Noongar groups that have an active interest in the areas that are habitat for *V. calthifolia*.

Social and economic impacts

The implementation of this recovery plan has minimal social and economic impact as all populations are on CALM managed land.

Evaluation of the Plan's Performance

The Department of Conservation and Land Management, in conjunction with the Albany District Threatened Flora Recovery Team will evaluate the performance of this recovery plan. In addition to annual reporting on progress against the criteria for success and failure, the plan is to be reviewed within five years of its implementation. Any changes to management / recovery actions made in response to monitoring results will be documented accordingly.

2. RECOVERY OBJECTIVE AND CRITERIA

IRP Objective: The objective of this Interim Recovery Plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild.

Recovery criteria

Criteria for success: The removal or reduction of identified threats resulting in an increase by ten percent or more in the number of individuals within populations and/or the stabilising of the population over the period of the plan's adoption under the EPBC Act.

Criteria for failure: Continuation of identified threats resulting in decrease by ten percent or more in the number of individuals within populations over the period of the plan's adoption under the EPBC Act.

3. RECOVERY ACTIONS

Existing recovery actions

CALM (Albany Work Centre) and the Ranger in Charge (Porongurup NP) have been notified of the location and threatened status of the species. The notification details the Declared Rare status *Villarsia calthifolia* and the legal responsibility to protect it.

Weed control in the park is implemented under the Regional Management Plan for the South Coast Region (1992) and the Stirling Range and Porongurup National Parks Management Plan (1999-2009). A specific weed control program for the Porongurup NP is planned which will aim to develop priorities based on the threat to conservation values (e.g. DRF), invasiveness, size of infestation, historical control and impact of disturbance.

Approximately 25,000 seeds collected from 3 populations in 1998 and 1 population in 2001 are stored in the Department's Threatened Flora Seed Centre (TFSC) at -18°C . TFSC staff test the viability of the seed initially and after one year in storage. The initial germination rate of *Villarsia calthifolia* seed was found to be up to 92% (range 44% -92%) (unpublished data, A. Cochrane³).

An information sheet, which includes a description of the plant, its habitat, threats, recovery actions and photos has been produced and distributed.

Staff from the Department's Albany Work Centre, Contract Botanists and CALM volunteers monitor populations of this species regularly.

Future recovery actions

The following recovery actions are roughly in order of descending priority; however this should not constrain addressing any of the priorities if funding is available for 'lower' priorities and other opportunities arise.

1. Coordinate recovery actions

The Albany District Threatened Flora Recovery Team (ADTFRT) is coordinating recovery actions for *Villarsia calthifolia* and will include information on progress in their annual report to the Department's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: The Department (Albany Work Centre) through the ADTFRT
Cost: \$3,000 per year.

2. Monitor populations

Regular monitoring of habitat degradation (including weed invasion and plant diseases), population stability (expansion or decline), pollination activity, seed production, recruitment and longevity is essential. All populations will be inspected regularly with special attention given to impacts from weeds and drought.

Action: Monitor populations
Responsibility: The Department (Albany Work Centre) through the ADTFRT
Cost: \$2,500 per year.

3. Conduct further surveys

³ Anne Cochrane, Manager, CALM's Threatened Flora Seed Centre

Further surveys will be conducted. Areas considered suitable for possible translocation will also be noted. Volunteers from the local community, Wildflower Societies and Naturalist Clubs will be encouraged to be involved in surveys supervised by Departmental staff.

Action: Conduct further surveys
Responsibility: The Department (Albany Work Centre) through the ADTFRT
Cost: \$3,700 per year

4. Undertake weed control

Four weeds (blackberry (*Rubus fruticosus*), red valerian (*Centranthus ruber*), taylorina (*Psoralea pinnata*) and dolichos (*Dipogon lignosis*) pose the most threat to *Villarsia calthifolia* and are considered priority for control within the Porongurup NP. Blackberry has the most potential to encroach upslope into *Villarsia calthifolia* habitat. These species are currently controlled by hand weeding or localised application of herbicide. The following actions will be implemented:

1. Prioritise areas and weed species to target for weed control based on threats to conservation values (e.g. presence of DRF), invasiveness, size of infestation, historical control and impact of disturbance.
2. Choose and implement appropriate weed control method/s.
3. Control invasive weeds by hand removal and/or spot spraying around *Villarsia calthifolia* plants when weeds first emerge.
4. Monitor the success of the treatment on weed death and the tolerance of *Villarsia calthifolia* and associated native plant species to the treatment.
5. Report on the method, timing, and success of the treatment, and effect on *Villarsia calthifolia* and associated native plants species.

Action: Undertake weed control according to the above program
Responsibility: The Department (Albany Work Centre) through the ADTFRT
Cost: \$5,200 per year.

5. Develop and implement a fire management strategy

The response of *Villarsia calthifolia* and its habitat to fire has not been documented although it is thought that occasional fire is necessary for recruitment. Until its affect is better understood fire will, if possible, be prevented from occurring in the area of populations except where it is being used experimentally or as a recovery tool. A fire management strategy will be developed to determine fire control measures and optimal fire regimes for the species. Monitoring plots have been established at Population 1A after a fire in Autumn 2003, to help determine the latter.

Action: Develop and implement a fire management strategy
Responsibility: The Department (Albany Work Centre) through the ADTFRT
Cost: \$4,200 in first year and \$2,000 in subsequent years

6. Collect seed and cutting material

Preservation of germplasm is essential to guard against the possible extinction of wild populations. Seed and cuttings can also be used to propagate plants for future translocations. Seed is required from all populations to maximise the genetic diversity of *ex situ* material. Cuttings will also be collected to establish a living collection of genetic material at the Botanic Garden and Parks Authority (BGPA).

Action: Collect seed and cutting material
Responsibility: The Department (Albany Work Centre) through the ADTFRT
Cost: 4,300 per year.

7. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this species will be promoted to the community through poster displays and the local print and electronic media. Formal links with local naturalist groups and interested individuals will also be encouraged.

Action: Promote awareness
Responsibility: The Department (Albany Work Centre) through the ADTFRT
Cost: \$1,400 in first year and \$1,100 in remaining years.

8. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Villarsia calthifolia* will provide a better scientific basis for management of the wild populations. An understanding of the following is particularly necessary for effective management:

1. Soil seed bank dynamics and the role of various disturbances (particularly the interaction of fire and weeds), competition and rainfall in germination and recruitment.
2. The pollination biology of the species, and the requirements of pollinators.
3. The phenology and seasonal growth of the species.
4. The population genetic structure, levels of genetic diversity and minimum viable population size.
5. Investigate the potential impact of grazing and /or trampling on the species.

Action: Obtain biological and ecological information
Responsibility: The Department (Science Division and Albany Work Centre) through the ADTFRT
Cost: \$20,800 per year for the first three years

9. Review the need for a full Recovery Plan and prepare if necessary

At the end of the fourth year of the five-year term of this Interim Recovery Plan, if the taxon is still ranked as Endangered, the need for a full Recovery Plan or a review of this IRP will be assessed and a plan prepared if necessary.

Action: Review the need for a full Recovery Plan and prepare if necessary
Responsibility: The Department (WATSCU and Albany Work Centre) through the ADTFRT
Cost: \$15,700 in the fifth year (if required).

4. TERM OF PLAN

This Interim Recovery Plan will operate from July 2004 to June 2009 but will remain in force until withdrawn or replaced. If the taxon is still ranked Critically Endangered after five years, the need to review this IRP or to replace it with a full Recovery Plan will be determined.

5. REFERENCES

- Aston, H.I. (1969). The genus *Villarsia* (Menyanthaceae) in Australia. *Muelleria* 2:3-63.
- Barrett, S. (1996) *A Biological Survey of Mountains in South Western Australia*. Department of Conservation and Land Management, Como.
- Barrett, S. (2002), *Rare Flora Report Forms – Villarsia calthifolia*, Department of Conservation and Land Management.
- Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia.
- Dixon, K.W. and Pate, J.S. (1981). Rare and Geographically Restricted Plants of Western Australia. 6: Plants with fleshy underground storage organs. Unpublished Report. Department of Fisheries and Wildlife, Perth.
- CALM (1992) Policy Statement No. 44 *Wildlife Management Programs*. Perth, Western Australia.

- CALM (1992). South Coast Region Regional Management Plan 1992-2002. Management Plan No. 24. Albany, Western Australia.
- CALM (1999). Stirling Range and Porongurup National Parks Management Plan. 1999-2009. Albany, Western Australia.
- CALM (1994) Policy Statement No. 50 *Setting Priorities for the Conservation of Western Australia's Threatened Flora and Fauna*. Perth, Western Australia.
- Elliot, W. R. and Jones, D.L. (1984) *Encyclopaedia of Australian Plants Suitable for Cultivation, Vol 3*. Lothian Publishing Co., Melbourne.
- Hopper, S.D., Brown, A.P. and Marchant, N.G.(1997). Plants of Western Australian granite outcrops. *Journal of the Royal Society of Western Australia*, 80:141-158.
- Ornduff, R. (1986). Comparative fecundity and population composition of heterostylus and non-heterostylus species of *Villarsia* (Menyanthaceae) in Western Australia. *American Journal of Botany* 73(2):282-286.
- Ornduff, R. (1996). An unusual floral monomorphism in *Villarsia* (Menyanthaceae) and its proposed origin from distyly. Pp. 212-222 in " Gondwanan Heritage: Past, Present and Future of the Western Australian Biota. Eds S.D. Hopper *et al.* Surrey Beatty and Sons, Chipping Norton.
- Pate, J.S. and Dixon, K.W. (1982). Tuberos, Cormous and Bulbous Plants. University of Western Australia Press, Perth, Western Australia.
- Peters, R.L. and Darling, J.D.S. (1985). The greenhouse effect and nature reserves. *Bioscience* 35: 707-717.
- Robinson, C.J and Coates, D.J. (1995). Declared Rare and Poorly Known Plants in the Albany District. Wildlife Management Program No. 20. Department of Conservation and Land Management, Perth, Western Australia.
- Western Australian Herbarium (1998) FloraBase – Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia. <http://www.calm.wa.gov.au/science/>
- World Conservation Union (2000) *IUCN red list categories prepared by the IUCN Species Survival Commission*, as approved by the 51st meeting of the IUCN Council. Gland, Switzerland.

6. TAXONOMIC DESCRIPTION

Aston, H.I. (1969). The genus *Villarsia* (Menyanthaceae) in Australia. *Muelleria* 2:3-63.

Large, erect, robust, apparently non-stoloniferous perennial. *Radical leaves* large on petioles 1-2 feet long: blades 5-16 cm long x 6-19 cm broad on herbarium specimens but noted by Mueller as almost 1 foot long and broad, almost round or either dimension slightly exceeding the other, apex rounded, base deeply cordate, sinus narrow, to 1/3 (-2/5) length of blade, basal lobes sometimes overlapping, margin strongly and irregularly toothed and teeth sometimes less pronounced, the teeth tips callose, texture thin to medium, upper surface glossy or matt, lower surface lightly dotted, veins quite noticeable at least below. *Culm* erect, measured to 3 feet high on incomplete specimens while Bentham (1868, p.374) cites Drummond as recording heights of 7-8 feet: cauline leaves present, at least the lower 4 radical-like, the blades to 7.5 cm long x 10.5 cm. broad on petioles to 19 cm long. *Inflorescence* a many-flowered panicle, the final branches and pedicels short, giving a semi-open to compact but not over-dense appearance: final bracts 5-7 mm long, broad-lanceolate to elliptic, acute; pedicels of mature capsules 7-12 mm long. *Flowers* homostylus; calyx lobes 6-9 mm long, broad-elliptic to broad-ovate, acute: corolla yellow, fimbriate at the throat, the lobes without any longitudinal keel or wing on the inner surfaces. *Capsule* (6-) 7-9 mm long, equal to or slightly greater than up to 1.5 mm longer than the calyx, broad-ovoid to ± urceolate, adnate at the base to the calyx tube, the apex and style usually falling by circumscission, the remaining capsule opening by a circular pore or by 4 (secondarily more) valves at the summit, the valves truncate, remaining erect or turning slightly outwards, rarely somewhat curved: capsule wall often thickened beneath the line of circumscission. Seed large, 1.5-1.8 mm long, straw-yellow to brownish, ellipsoid, very turgid, somewhat laterally compressed, the surface with a minute, reticulated pattern and densely covered with short hollow, tapered tubercles, without a conspicuous caruncle.

⁴**SUMMARY OF RECOVERY ACTIONS AND COSTS**

Recovery Action	Year 1			Year 2			Year 3			Year 4			Year 5		
	Dept	Other	Ext.	Dept	Other	Ext.	Dept	Other	Ext.	Dept	Other	Ext.	Dept	Other	Ext.
Coordinate recovery actions	1800	600	600	1800	600	600	1800	600	600	180	600	600	1800	600	600
Monitor populations	1400	500	600	1400	500	600	1400	500	600	1400	500	600	1400	500	600
Conduct further surveys	1500	1000	1200	1500	1000	1200	1500	1000	1200	1500	1000	1200	1500	1000	1200
Undertake weed control	3000	1000	1200	3000	1000	1200	3000	1000	1200	3000	1000	1200	3000	1000	1200
Develop and implement a fire management strategy	1900		2300	300		1700	300		1700	300		1700	300		1700
Collect seed and cutting material	1400	500	2400	1400	500	2400	1400	500	2400	1400	500	2400	1400	500	2400
Promote awareness	600		800	600		300	600		300	600		300	600		300
Obtain biological and ecological information	10800		10000	10800		10000	10800		10000						
Review the need for a full Recovery Plan and prepare if necessary													6600		9100
Total	22400	3600	19100	20800	3600	18000	20800	3600	18000	8380	3600	8000	16600	3600	17100
Yearly Total	45,100			42,400			42,400			19,980			37,300		

NHT = External funding (funding to be sought), Other = in-kind contribution and BGPA.

Total Department: \$88,980
 Total Other: \$18,000
 Total External Funding: \$80,200
TOTAL COSTS: \$187,180

⁴ Figures based on 2004/2005 estimates

